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Subjects 2202 (1012, 1236, 1310, 1564, 583)

333 Pfingsten Road
 Northbrook, IL 60062
 March 3, 1995

TO: Electrical Council of Underwriters Laboratories Inc.,
 Subscribers to UL's Standards Services for Electric Vehicle (EV) Charging System
 Equipment, Power Units Other Than Class 2, Battery Chargers for Charging
 Engine-Starter Batteries, Class 2 Power Units, Industrial Battery Chargers, and
 Ice Makers

SUBJECT: Announcement of UL's Outline of Investigation for Electric Vehicle (EV) Charging System
 Equipment

UL announces the first issue of the Outline of Investigation for Electric Vehicle (EV) Charging System
 Equipment, Subject 2202, that covers UL's Listing Service for EV charging system equipment and EV
 battery chargers.

These requirements cover electric vehicle (EV) charging system equipment, intended to be supplied by a
 branch circuit of 600 volts or less, for recharging the storage batteries of over-the-road EVs. The
 requirements cover either conductive or inductive EV charging system equipment. These chargers may
 be either cord and plug connected or permanently connected. The battery charger can be located on-
 or off-board vehicle. An off-board charger can be for indoor or outdoor use.

EV charging system equipment that is not a complete assembly and depends upon installation in an EV
 or end product for compliance with the requirements in this outline is investigated under the
 requirements of this outline and the standard for the end product.

Manufacturers interested in using this service are encouraged to contact the UL office that normally
 handles the investigation of their products. The following is a list of the engineers who can be contacted
 for inquiries:

Ron Hagen (Ext. 42895) at UL's Northbrook, IL office
 Bahram Barzideh (Ext 22982) at UL's Melville, NY office
 Charles Smith (Ext. 2363) at UL's Santa Clara, CA office
 Kent Donohue (Ext. 1645) at UL's RTP, NC office

Copies of UL's Subject 2202, Outline of Investigation, are available for \$125.00 per copy. Orders with
 payment should be sent to:

Publication Stock
 Underwriters Laboratories Inc.
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March 3, 1995

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**Underwriters Laboratories Inc.®**A not-for-profit organization dedicated to public safety
and committed to quality service**April 6, 1994****Revision pages for****Standard for****Industrial Battery Chargers****UL 1564, Second Edition**

Attached to this transmittal notice is a reprinted title page for the second edition of UL 1564.

Attention is directed to the note on the title page of this standard outlining the procedure to be followed to retain the approved text of ANSI/UL 1564-1994.

Revised and/or additional pages may be issued from time to time.

With the inclusion of the accompanying material, the standard consists of pages dated as shown in the following checklist:

Page	Date
1	November 24, 1993 (Reprinted: April 6, 1994)
2 – 58	November 24, 1993
A1	November 24, 1993

(1)

NOVEMBER 24, 1993
(Title Page Reprinted: April 6, 1994)



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UL 1564

Standard for

Industrial Battery Chargers

First Edition – December, 1982

Prior to the first edition, the requirements were included in the Standard for Electric Battery Chargers, numbered UL 1236.

Second Edition

November 24, 1993

Approval as an American National Standard (ANSI) covers the numbered paragraphs on pages dated November 24, 1993. These pages should not be discarded when revised or additional pages are issued if it is desired to retain the ANSI approved text.

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

Approved as ANSI/UL 1564-1985, March 8, 1985
Approved as ANSI/UL 1564-1994, February 14, 1994

Revisions of this standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest published set of revision pages.

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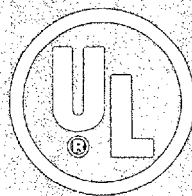
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Industrial Battery Chargers



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Standard



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November 24, 1993

Standard for

Industrial Battery Chargers

UL 1564, Second Edition

Accompanying this transmittal notice is a copy of the second edition of UL 1564.

THIS EDITION OF THE STANDARD IS NOW IN EFFECT.

Revised and/or additional pages may be issued from time to time.

Subscribers to UL's services in the area covered by this standard will receive these revised and/or additional pages automatically. Others may receive such pages by subscribing to UL's subscription service for revisions. See UL's CATALOG OF STANDARDS FOR SAFETY for a description of the revision subscription service, the cost of the service for this standard, and ordering information.



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November 24, 1993

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FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction differing from those detailed in the requirements of this Standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1.1 These requirements cover indoor battery chargers rated 600 volts or less. They are intended to be used in accordance with the National Electrical Code, NFPA 70, to charge industrial storage batteries which are used to provide power for material handling trucks, tractors, personnel carriers, and similar motive equipment. These chargers may be either cord and plug connected or permanently connected.

1.2 A battery charger that is not a complete assembly and depends upon installation in an end product for compliance with the requirements in this standard is investigated under the requirements of this standard and the standard for the end product.

1.3 These requirements do not cover:

- a) Battery chargers for use in a marina, boatyard, or other marine application;
- b) Battery chargers for fire protection signaling service;
- c) Household battery chargers;
- d) Automotive battery chargers;
- e) Battery chargers for use with an internal combustion engine driving a centrifugal fire pump; or,
- f) Appliances or systems in which a battery charger is used.

1.4 A product that contains features, characteristics, components, materials, or systems new or different from those in use when the standard was developed, and that involves a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain the level of safety for the user of the product as originally anticipated by the intent of this standard.

2 General

2.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

3 Glossary

3.1 In the following text, the term "product" is used to mean an industrial battery charger.

3.2 For the purpose of this standard, the following definitions apply.

3.3 CLASS 2 TRANSFORMER — A step-down transformer having a secondary voltage of no more than 30 volts, rms — 42.4 volts peak — acceptable for use with Class 2 low-energy supply circuits, in accordance with the National Electrical Code, ANSI/NFPA 70. Unless such a transformer is the energy-limiting type, having sufficient winding impedance to limit the current output to a specified maximum value, an acceptable secondary-circuit fuse or other overcurrent-protective device is included.

3.4 INDUSTRIAL BATTERY — A battery that is intended for cycling service and is rated in number of cells and in ampere-hours delivered at the 6-hour discharge rate.

4 Components

4.1 Except as indicated in 4.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

4.2 A component need not comply with a specific requirement that:

- a) Involves a feature or characteristic not needed in the application of the component in the product covered by this standard; or
- b) Is superseded by a requirement in this standard.

4.3 A component shall be used in accordance with its recognized rating established for the intended conditions of use.

4.4 Specific components are recognized as being incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions for which they have been recognized.

5 Units of Measurement

5.1 If a value for measurement is followed by a value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement.

CONSTRUCTION

6 Frame and Enclosure

6.1 A product shall be formed and assembled so that it will have the strength and rigidity necessary to resist the abuses to which it may be subjected, without increasing the risk of fire, electric shock, or injury to persons due to a total or partial collapse resulting in a reduction of spacings, loosening or displacement of parts, or other serious defects.

6.2 A product that complies with the requirements in 6.3 – 6.8 is considered to comply with the requirements in 6.1.

6.3 A product shall be provided with an enclosure that shall house all parts – other than the power-supply cord or primary connector and the output leads or terminals – that may increase the risk of fire, electric shock, or injury to persons under any condition of use.

6.4 The thickness of a sheet-metal enclosure shall not be less than that specified in Tables 6.1 and 6.2, except that uncoated steel shall not be less than 0.032 inch (0.81 mm) thick, zinc-coated steel shall not be less than 0.034 inch (0.86 mm) thick, and nonferrous metal shall not be less than 0.045 inch (1.14 mm) thick at points at which a wiring system is to be connected.

Table 6.1
Thickness of sheet metal for enclosures – carbon steel or stainless steel

Without supporting frame ^a		With supporting frame or equivalent reinforcing ^a		Minimum thickness, Inch (mm)	
Maximum width ^b Inches (cm)	Maximum length ^c Inches (cm)	Maximum width ^b Inches (cm)	Maximum length ^c Inches (cm)	Uncoated	Zinc coated
4.0 (10.2) 4.75 (12.1)	Not limited 5.75 (14.6)	6.25 (15.9) 6.75 (17.1)	Not limited 8.25 (21.0)	0.020 (0.51)	0.023 (0.58)
6.0 (15.2) 7.0 (17.8)	Not limited 8.75 (22.2)	9.5 (24.1) 10.0 (25.4)	Not limited 12.5 (31.8)	0.026 (0.66)	0.029 (0.74)
8.0 (20.3) 9.0 (22.9)	Not limited 11.5 (29.2)	12.0 (30.5) 13.0 (33.0)	Not limited 16.0 (40.6)	0.032 (0.81)	0.034 (0.86)
12.5 (31.8) 14.0 (35.6)	Not limited 18.0 (45.7)	19.5 (49.5) 21.0 (53.3)	Not limited 25.0 (63.5)	0.042 (1.07)	0.045 (1.14)
18.0 (45.7) 20.0 (50.8)	Not limited 25.0 (63.5)	27.0 (68.6) 29.0 (73.7)	Not limited 36.0 (91.4)	0.053 (1.35)	0.056 (1.42)
22.0 (55.9) 25.0 (63.5)	Not limited 31.0 (78.7)	33.0 (83.8) 35.0 (88.9)	Not limited 43.0 (109.2)	0.060 (1.52)	0.063 (1.60)
25.0 (63.5) 29.0 (73.7)	Not limited 36.0 (91.4)	39.0 (99.1) 41.0 (104.1)	Not limited 51.0 (129.5)	0.067 (1.70)	0.070 (1.78)
33.0 (83.8) 38.0 (96.5)	Not limited 47.0 (119.4)	51.0 (129.5) 54.0 (137.2)	Not limited 66.0 (167.6)	0.080 (2.03)	0.084 (2.13)
42.0 (106.7) 47.0 (119.4)	Not limited 59.0 (149.9)	64.0 (162.6) 68.0 (172.7)	Not limited 84.0 (213.4)	0.093 (2.36)	0.097 (2.46)
52.0 (132.1) 60.0 (152.4)	Not limited 74.0 (188.0)	80.0 (203.2) 84.0 (213.4)	Not limited 103.0 (261.6)	0.108 (2.74)	0.111 (2.82)
63.0 (160.0) 73.0 (185.4)	Not limited 90.0 (228.6)	97.0 (246.4) 103.0 (261.6)	Not limited 127.0 (322.6)	0.123 (3.12)	0.126 (3.20)
^a See 6.5. ^b The width is the smaller dimension of a rectangular piece of sheet metal that is part of an enclosure. Adjacent surfaces of an enclosure may have supports in common and be made of a single sheet. ^c Not limited applies only if the edge of the surface is flanged at least 1/2 inch (12.7 mm) or is fastened to an adjacent surface not normally removed in use.					

Table 6.2
Thickness of sheet metal for enclosures — aluminum, copper, or brass

Without supporting frame ^a		With supporting frame or equivalent reinforcing ^a		Minimum thickness Inch (mm)
Maximum width ^b Inches (cm)	Maximum length ^c Inches (cm)	Maximum width ^b Inches (cm)	Maximum length ^c Inches (cm)	
3.0 (7.6) 3.5 (8.9)	Not limited 4.0 (10.2)	7.0 (17.8) 8.5 (21.6)	Not limited 9.5 (24.1)	0.023 (0.58)
4.0 (10.2) 5.0 (12.7)	Not limited 6.0 (15.2)	10.0 (25.4) 10.5 (26.7)	Not limited 13.5 (34.3)	0.029 (0.74)
6.0 (15.2) 6.5 (16.5)	Not limited 8.0 (20.3)	14.0 (35.6) 15.0 (38.1)	Not limited 18.0 (45.7)	0.036 (0.91)
8.0 (20.3) 9.5 (24.1)	Not limited 11.5 (29.2)	19.0 (48.3) 21.0 (53.3)	Not limited 25.0 (63.5)	0.045 (1.14)
12.0 (30.5) 14.0 (35.6)	Not limited 16.0 (40.6)	28.0 (71.1) 30.0 (76.2)	Not limited 37.0 (94.0)	0.058 (1.47)
18.0 (45.7) 20.0 (50.8)	Not limited 25.0 (63.5)	42.0 (106.7) 45.0 (114.3)	Not limited 55.0 (139.7)	0.075 (1.91)
25.0 (63.5) 29.0 (73.7)	Not limited 36.0 (91.4)	60.0 (152.4) 64.0 (162.6)	Not limited 78.0 (198.1)	0.095 (2.41)
37.0 (94.0) 42.0 (106.7)	Not limited 53.0 (134.6)	87.0 (221.0) 93.0 (236.2)	Not limited 114.0 (289.6)	0.122 (3.10)
52.0 (132.1) 60.0 (152.4)	Not limited 74.0 (188.0)	123.0 (312.4) 130.0 (330.2)	Not limited 160.0 (406.4)	0.153 (3.89)

^a See 6.5.

^b The width is the smaller dimension of a rectangular piece of sheet metal that is part of an enclosure. Adjacent surfaces of an enclosure may have supports in common and be made of a single sheet.

^c Not limited applies only if the edge of the surface is flanged at least 1/2 inch (12.7 mm) or is fastened to an adjacent surface not normally removed in use.

6.5 With reference to Tables 6.1 and 6.2, a supporting frame is a structure of angle, channel, or a folded rigid section of sheet metal, that is rigidly attached to and has essentially the same outside dimensions as the enclosure surface and that has sufficient torsional rigidity to resist the bending moments that may be applied by the enclosure surface when it is deflected. Construction that is considered to have equivalent reinforcing may be accomplished by designs that will produce a structure that is as rigid as one built with a frame of angles or channels. Construction considered to be without a supporting frame includes:

- A single sheet with single formed flanges (formed edges);
- A single sheet that is corrugated or ribbed; and
- An enclosure surface loosely attached to a frame (for example, by means of spring clips).

6.6 An enclosure consisting of wire mesh, perforated screens, or grillwork shall be provided with a rigid supporting frame such that the deformation of a guard or enclosure will not result in contact with live parts.

6.7 The diameter of the wires of a screen shall not be less than 0.0598 inch (1.519 mm) if the screen openings are 1/2 square inch (3.2 cm²) or less in area and shall not be less than 0.100 inch (2.54 mm) for larger screen openings.

6.8 Perforated sheet steel and sheet steel used for expanded metal mesh shall not be less than 0.042 inch (1.07 mm) thick, 0.058 inch (1.47 mm) thick if nonferrous, if the mesh openings or perforations are 1/2 square inch (3.2 cm²) or less in area, and shall not be less than 0.080 inch (2.03 mm) thick, 0.112 inch (284 mm) thick if non-ferrous, for larger openings.

Exception: In a small charger where the indentation of a guard or enclosure will not affect the clearance between uninsulated, movable, current-carrying parts and grounded metal, 0.020 inch (0.51 mm) steel or 0.029 inch (0.74 mm) nonferrous expanded metal mesh may be employed, provided that:

a) The exposed mesh on any one side or surface of the battery charger that is so protected has an area of 72 square inches (465 cm²) or less and does not have any dimension greater than 12 inches (305 mm); or

b) The width of the protected opening is 3-1/2 inches (88.9 mm) or less.

6.9 If an electrical instrument, such as a meter, forms part of the enclosure, the face or the back of the instrument housing, or both together, shall comply with the requirements for an enclosure.

Exception No. 1: An electrical instrument connected in a secondary circuit, if damage to or deterioration of the materials of which the housing is made will not result in a risk of fire or electric shock, does not need to be tested.

Exception No. 2: A meter complying with the requirements in the Standard for Electrical Analog Instruments – Panelboard Types, UL 1437 will not require testing.

6.10 Material supporting terminals or used as internal electrical insulation of an electrical instrument shall comply with the requirements in Insulating Materials, Section 15. The acceptability of spacings between live and dead metal parts connected to the enclosure within the instrument shall be determined by compliance with the requirements in 32.1.1.

Exception No. 1: An electrical instrument connected in a secondary circuit, if damage to or deterioration of the materials will not result in a risk of fire or electric shock, does not need to be tested.

Exception No. 2: A meter complying with the requirements in the Standard for Electrical Analog Instruments – Panelboard Types, UL 1437 will not require testing.

6.11 Supporting feet of a product that form part of the enclosure or are needed for ventilation shall be reliably secured and the aging, physical, and flammability properties of the material shall be investigated. The effect of oil and the absorption of moisture on the mounting feet are also to be considered.

Exception: Rubber may be accepted without testing if it does not form part of the enclosure and is not needed to provide ventilation.

6.12 An enclosure, frame, or cover of a material other than sheet metal shall provide protection equivalent to that required by 6.4.

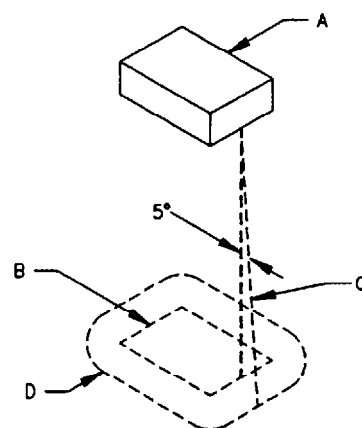
6.13 Among the factors taken into consideration when judging the acceptability of a nonmetallic enclosure are:

- a) Mechanical strength;
- b) Resistance to impact;
- c) Moisture-absorptive properties;
- d) Combustibility;
- e) Resistance to distortion at temperatures to which the material may be subjected under conditions of normal or abnormal usage; and
- f) Resistance to arcing.

The enclosure material shall not display a loss of a property beyond the minimum acceptable level as a result of aging. See the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

6.14 The combination of enclosure and internal barriers of a product shall prevent molten metal, burning insulation, flaming particles, or the like, from falling onto combustible materials, including the surface upon which the charger is supported. See Figure 6.1. An internal barrier may be an integral part of a component or of the charger enclosure.

Figure 6.1
Location and extent of barrier



SA0604-1

a – Region to be shielded by barrier. This will consist of the entire component if it is not otherwise shielded, and will consist of the unshielded portion of a component that is partially shielded by the component enclosure or equivalent.

b – Projection of outline of component on horizontal plane.

c – Inclined line that traces out minimum area of barrier. When moving, the line is always

- 1) Tangent to the component;
- 2) 5 degrees from the vertical; and
- 3) So oriented that the area traced out on a horizontal plane is maximum.

d – Location (horizontal) and minimum area for barrier. The area is that included inside the line of intersection traced out by the inclined line C and the horizontal plane of the barrier.

6.15 Compliance with the requirements in 6.14 is determined by the requirements in 6.16 and 6.17.

6.16 To comply with the requirement in 6.14, an enclosure having openings in the bottom wall shall be provided with a barrier in accordance with Figure 6.1 unless the components enclosed are as described in the following:

- a) Individually enclosed when arcing parts such as a switch, relay, or contactor are involved.
- b) A motor without openings in the bottom of the housing unless:
 - 1) The overload protection provided with the motor is such that no burning insulation or molten material falls to the surface that supports the product when the motor is energized under each of the following fault conditions:
 - i) Open main winding,

- ii) Open starting winding, and
 - iii) Starting switch short-circuited;
- 2) The motor is provided with a thermal protector that is sensitive to temperature and current and that will prevent the temperature of the motor winding from exceeding:
- i) 125°C (257°F) when the motor is running at the maximum load at which it can operate without causing the protector to cycle, and
 - ii) 150°C (302°F) with the rotor of the motor locked; or
- 3) The motor complies with the requirements for impedance-protected motors and the temperature of the motor winding will not exceed 150°C during the first 72 hours of operation with the rotor locked.
- c) Internal wiring insulated with neoprene, thermoplastic, impregnated asbestos or fiber-glass, or an equally flame-retardant material.
- d) An individually enclosed fuse, such as an extractor type. Consideration will be given to a fuse enclosed within a transformer winding.

Exception: A battery charger marked in accordance with 47.2.5 need not comply with (a) and (d).

6.17 If a ventilating opening is located in the bottom of the enclosure, a component having a magnetic winding or coil, such as a relay or solenoid shall either be:

- a) Individually and completely enclosed; or
- b) If applicable, subjected to the burnout tests described in 39.1 and 39.2.

7 Accessibility of Live Parts

7.1 General

7.1.1 To reduce the risk of unintentional contact by persons with an uninsulated live part, an opening in the enclosure shall comply with 7.1.2.

7.1.2 Openings in an enclosure, including holes, louvers, and openings protected by means of wire screening, expanded metal, or perforated covers, shall be of such size or shape that no opening will permit passage of a rod having a diameter of 1/2 inch (12.7 mm).

Exception: If the distance between any live part and the enclosure is 4 inches (102 mm) or more, an opening may be larger than 1/2 inch but shall not permit passage of a rod having a diameter of 3/4 inch (19.1 mm).

7.1.3 A door or cover that provides access to a live part that can result in a risk of electric shock shall be securely held in place so that a tool is required to open or remove it.